Tracor Instruments

TSG 888A-1
LINEAR PHASE RECORDER

OPERATION MANUAL -SV S69022C

SERIAL NO. 850628

TREMETRICS (FORMALLY TRACOR INST.)
2215 GRAND AVENUE PKY
AUSTIN, TX 78728
(512) 251-1400

February 1983

CHART PAPER ROLLS (3650-0008)
GEORGIA BARNARD $44.00

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Tracor Instruments

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9. This warranty shall be governed by the laws of Texas.

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SECTION I

GENERAL INFORMATION

1-1. PURPOSE OF THE MODEL 888-A.

1-2. Linear Phase Recorder Model 888-A measures the difference in phase between two signals. The rate of change of phase between the signals must be slow for accurate comparison. Therefore, the 888-A is best used to measure the drift rate between accurate frequency standards, phase shift in circuits, etc.

1-3. If two frequency standards, which are at exactly the same frequency, are compared in the Model 888-A, a straight-line record indication of some arbitrary phase difference would result. If a frequency difference exists between the standards, the recording will have some slope and will trace a record between 0° and 360°. The frequency difference between the input signals can be determined by noting the time required for one such cycle to occur.

1-4. The relative drift rate between two standards can be determined by noting the rate of change of slope of the record.

1-5. Please note the following example:

EXAMPLE

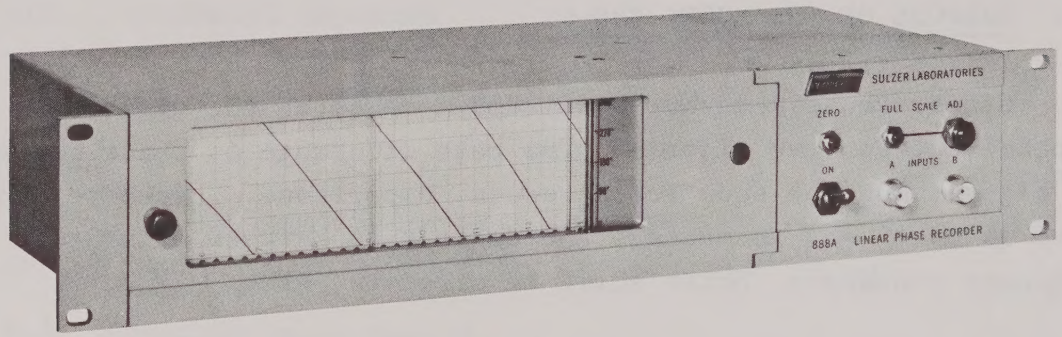
Two signals approximately 5 MHz.

One full trace requires 1000 seconds.

An hour later one full trace requires only 980 seconds.

Frequency difference observation 1 =

$$\frac{\frac{1}{5 \times 10^{6}}}{1000 \text{ sec.}} = \frac{2 \times 10^{-7} \text{ sec.}}{1000 \text{ sec.}} = 2 \times 10^{-10}$$



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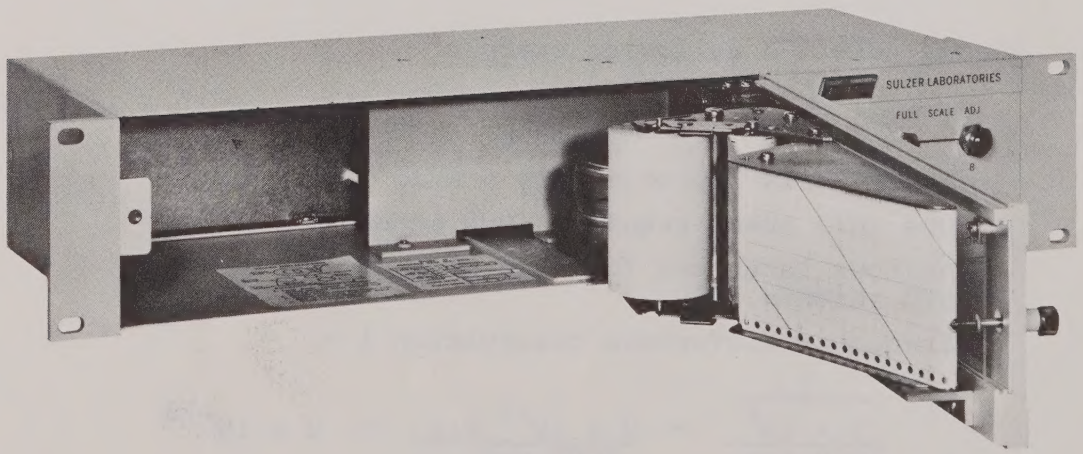

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Figure 1-1. Linear Phase Recorder Model 888-A

Frequency difference observation 2 =

$$\frac{2 \times 10^{-7} \text{ sec.}}{980 \text{ sec.}} = 2.04 \times 10^{-10}$$

Relative drift = Approximately 4×10^{-12}/hour

Once the frequency offset is known the phase detector follows the relationship:

$$\Delta t = 8.64 \frac{\Delta f}{f} T + 4.32KT^2$$

Δt = time lost or gained during T days

$\frac{\Delta f}{f}$ = frequency offset in parts in 10^{10} per day

The resolution of the 888-A is 5 nanoseconds; therefore, drift rates as low as 1×10^{-13} per day can be detected.

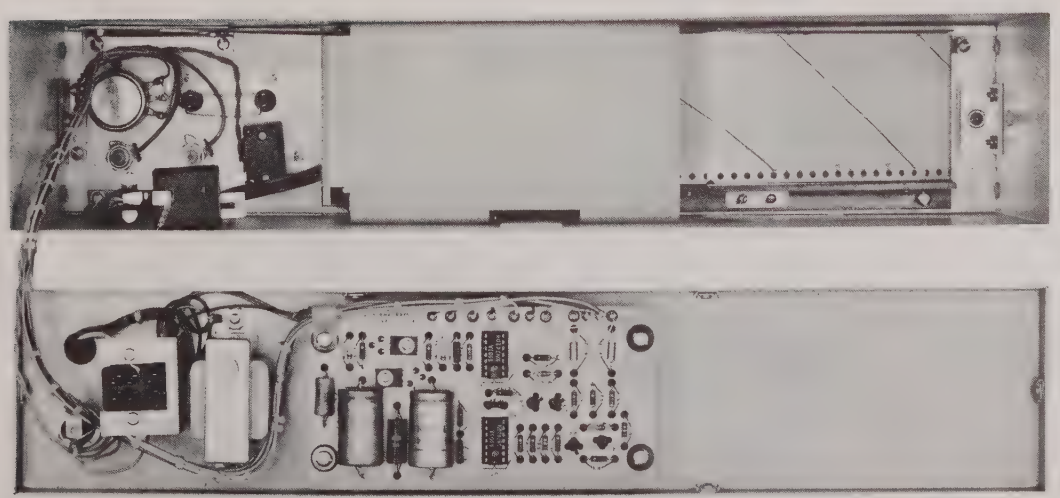

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Figure 1-2. Rear View of Model 888-A Showing Rear Panel Removed

1-6. ACCURACY IN THE 888-A.

1-7. The resolution of the 888-A is readily definable and easily understood. The accuracy is quite another matter.

1-8. There are several accuracies to consider in the 888-A. They are: the electronics, the galvanometer, the chart paper and the chart drive. The overall accuracy is the product of the various accuracies.

1-9. Certain methods of interpreting the data provided by the 888-A allow the best accuracy of the group to be used and extremely close measurements can be made. Other methods preclude this and permit only rough measurements.

1-10. Obviously the methods which give the most accurate results should be used. The methods vary somewhat with frequency, and a good understanding of the 888-A's output is necessary to select the best method.

1-11. ACCURACY IN DRIFT MEASUREMENTS.

1-12. How can relative drift between the input signals best be determined? Assume input frequencies are $\approx$ 5 MHz. If the drift is taken to be the difference in time between phase changes of 360° (i.e., between two cycles), the accuracy of the electronics is 5 nanoseconds, the accuracy of the galvanometer is unimportant. Inaccuracies in the paper will be assumed to be negligible and the motor speed non-varying.

1-13. With an offset of 2×10^{-10} the drift rate can be determined with an accuracy of about 2×10^{-12}. If the average of several such measurements are taken, the drift can be closely determined.

1-14. The accuracy of drift measurements using this method remains the same regardless of frequency.

1-15. ACCURACY IN PHASE MEASUREMENTS.

1-16. Unlike accuracies for drift measurements, it is quite simple to give accuracies for phase measurement. The accuracy is inversely related to the frequency. Accuracy at 1 MHz and below is better than 95%. At 5 MHz it is usually 87%. The inaccuracies are caused by a fixed "dead band" of 26 nanoseconds in the phase measurement circuit. At low frequencies this amount of "dead band" is negligible. At frequencies above 1 MHz it becomes significant.

1-17. 888-A CHART RECORD.

1-18. The output of the 888-A is a chart recording which indicates the change of phase with time between the two inputs. Note the

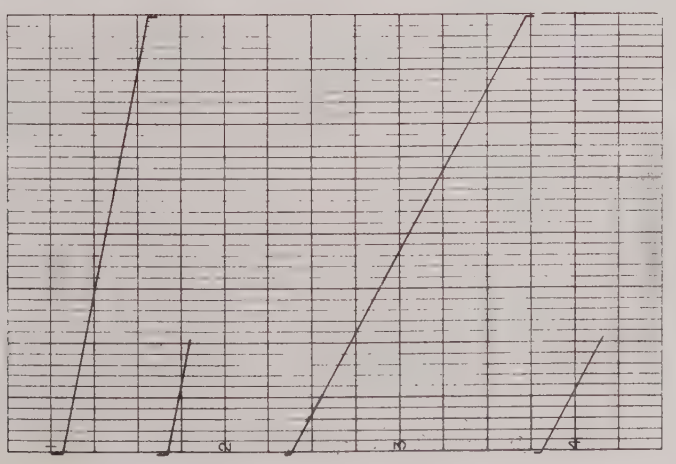

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Figure 1-3. Typical Chart Record

typical chart record shown in figure 1-3. This figure depicts an actual chart record of an 888-A comparing a Sulzer Model 5D and a Model 2.5B. The first trace was taken with both inputs at 5 MHz. The second trace was taken at 1 MHz. The first trace required approximately 2160 seconds. The second trace took about 5040 seconds.

Trace 1: $\frac{2 \times 10^{-7}}{2160} = 9.25 \times 10^{-11}$

Trace 2: $\frac{1 \times 10^{-6}}{\cancel{2160}\ 5040} = 1.98 \times 10^{-10}$

The two traces were taken some time apart, which accounts for the offset difference. Note that the "dead band" at 1 MHz is much smaller than at 5 MHz.

1-19. There is a "dead band" at the top and bottom of each trace. The "dead band" occurs when the signals are so close in phase that the electronics do not switch. The "dead band" causes no real difficulty.

EXAMPLE

The 888-A is being used to measure the offset between two cesium standards at 5 MHz. The trace stays in the lower "dead band" for an hour (each "dead band" is 13 nanoseconds).

Offset = $\frac{13 \times 10^{-9} \text{ sec.}}{3600 \text{ sec.}} = 3.61 \times 10^{-12}$

SECTION II

SPECIFICATIONS

2-1. ELECTRICAL.

Inputs:	Sinewave 100 Hz - 5 MHz, 0.5 to 10 volts R.M.S. Squarewave 100 Hz - 5 MHz, 1.5 to 30 volts p-p. Input impedance greater than 500 ohms.
Recorder:	1 inch per hour, 3600 strikes per hour. Rectilinear paper 0 - 360°.
Resolution:	9° per minor division.
Phase Measurement Accuracy:	Better than 95% at 1 MHz and below. Typically 87% at 5 MHz. Accuracy is related to frequency and is limited by circuit switching time.
Drift Measurement Accuracy:	Absolute accuracy is 5 nanosec. at all frequencies.
Power Requirements:	105 - 130 VAC, 60 Hz, 5 watts.

2-2. PHYSICAL.

Size:	3 ½ x 7 ½ x 19 in. wide for standard rack mounting.
Front Panel Controls:	Zero adjustment. FULL SCALE ADJ. ZERO and FULL SCALE pushbutton switches. Power ON switch.
Front Panel Connections:	Signal inputs A and B, Type BNC.

Rear Panel Fuse:	AC ½ amp.
Weight:	8 pounds.

SECTION III

INSTALLATION AND OPERATION

3-1. UNPACKING.

3-2. Check for broken fuse holders, broken front window, cut power cable, etc. Check for damage to shipping carton and corresponding surface damage to the Model 888-A.

3-3. PREPARATION FOR USE.

3-4. Prepare the recorder for use as follows:

a. Mount unit in a relay rack or place on bench.
b. Open hinged front panel and make sure recorder has chart paper properly in place. Reclose panel.
c. Connect signals to inputs A and B.
d. Connect power cord to 115 VAC outlet.

3-5. OPERATING THE MODEL 888-A.

3-6. After AC power has been applied, place power ON switch to ON. The recorder should operate and the striker bar should strike the pressure-sensitive paper once each second.

3-7. With both inputs connected, and with appropriate signals, the recorder needle should be on scale. Press the ZERO pushbutton and the recorder should indicate zero degrees. The zero adjustment adjusts the mechanical zero of the galvanometer and does not require frequent adjustment. If adjustment is required, remove the plug at the right of the scale, depress the ZERO pushbutton, and make the adjustment.

3-8. The FULL-SCALE adjustment should be checked frequently

and readjusted each time input frequencies are changed. To adjust for full scale, loosen the lock nut on the FULL SCALE control, depress the FULL SCALE pushbutton, and adjust the control for a full scale reading on the galvanometer. Re-tighten the lock nut after completing the adjustment.

3-9. Once these two adjustments are made, the Model 888-A requires no attention except to replace the chart paper when a roll is exhausted.

SECTION IV

THEORY OF OPERATION

4-1. FUNCTIONAL DESCRIPTION.

4-2. The Model 888-A Linear Phase Recorder consists of a chassis frame, a galvanometer-recorder, and electronic circuitry.

4-3. The electronic circuitry (figure 4-1) includes a power supply, two Schmitt trigger circuits, two single-shot multivibrators, a flip-flop, and an output buffer The Schmitt triggers clip and shape the input signals. The squared outputs of the Schmitt circuits trigger the two single-shots, which produce very short pulses that alternately set and reset the flip-flop.

4-4. The action of the Schmitt circuits and single-shots is such that the pulses always occur at a particular point on the input signal. Therefore, the period of flip-flop is directly related to the difference in phase of the input signals.

4-5. The signal from the flip-flop is buffered and fed through limiting resistors to the recorder. The recorder responds to the average of the period of the flip-flops. This average is recorded on pressure sensitive chart paper.

4-6. DETAILED CIRCUIT DESCRIPTION.

4-7. SCHMITT TRIGGERS.

4-8. There are two identical Schmitt trigger circuits. (Refer to figure 7-1.) Since they are identical, only one will be discussed. Input stage Q1 is biased on. When the input signal goes negative, Q1 turns off and Q2 turns on. The regenerative action

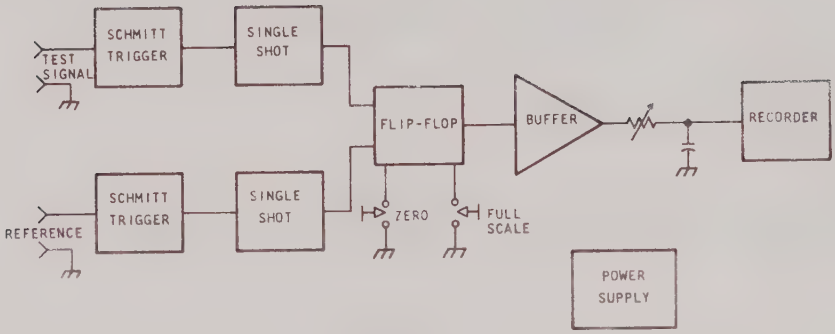

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Figure 4-1. Linear Phase Recorder Block Diagram

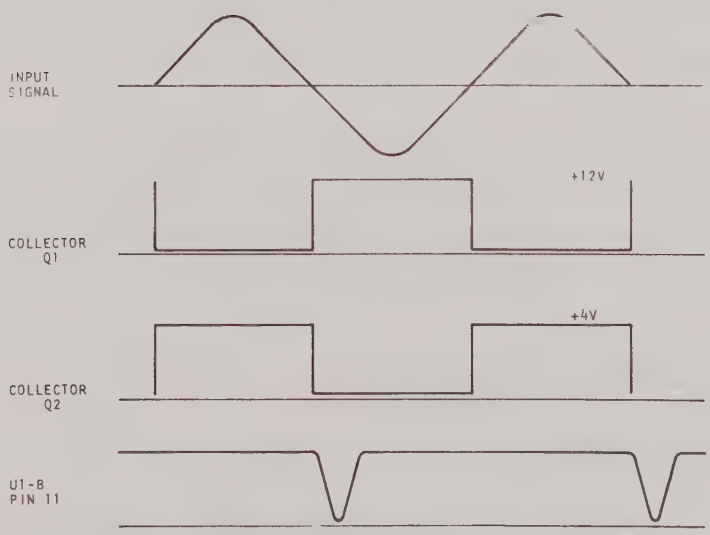

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Figure 4-2. Typical Waveforms

of the circuit is such that the off-on transitions are extremely fast. The wave shape at the collector of Q2 is a squared, clipped signal in phase with the input. (Refer to figure 4-2 for typical waveforms.)

4-9. The collector of Q2 is returned to +5 volts and the output signal is always at either a 1- or a 0- logic level. The signal at the collector of Q2 feeds the single shots.

4-10. SINGLE SHOTS - FLIP FLOP STAGE.

4-11. There are two identical single shots, each made with TTL quad two-input NAND-gates. These single shots produce short negative-going pulses at the trailing edge of the input signal. The trailing edge is selected for trigger purposes because the fast fall time of the Schmitt circuits (8-12 nsec.) helps reduce jitter. The duration of output pulses of the single-shots is about 30 nanoseconds with rise and fall times of approximately 10 nanoseconds. These pulses are used to set or reset the flip-flop.

4-12. The flip-flop consists of two cross-coupled, TTL triple-input NAND-gates. There are two inhibit inputs to the flip-flop that allow the ZERO and FULL SCALE pushbuttons to operate even when input signals exist. The period of the flip-flop is directly proportional to the difference in phase of the two input signals. Switching occurs at the trailing edge of the input signals.

4-13. BUFFER STAGE.

4-14. One section of the NAND-gate is used as a buffer. This buffer inverts the output from the flip-flop and prevents loading the flip-flop. The output of the buffer is fed through the full scale potentiometer to the recorder. The buffer is protected against excessive current drain by R16.

4-15. The squarewave output of the buffer is filtered by C1 and averaged by the response of the meter. The meter reading corresponds to the duty cycle of the flip-flop.

4-16. POWER SUPPLY.

4-17. The power supply provides 12 VDC and 5 VDC for the phase detector circuitry.

4-18. The circuitry for the power supply consists of a half wave rectifier, filter capacitor, series regulator, and shunt regulator. Series regulator Q5 supplies the 12 VDC and shunt regulator Q6 supplies 5 VDC for the TTL logic. Each regulator employs straight forward circuits.

SECTION V

MAINTENANCE

5-1. The Model 888-A requires no maintenance other than replenishing the chart paper. Refer to the pamphlet enclosed with each 888-A for instruction on chart paper replacement.

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains all necessary information for quick identification and ordering of replaceable parts for the Linear Phase Recorder Model 888-A. The section contains a list of replaceable parts, a numeric list of Federal Supply Codes for manufacturers, and ordering information.

6-3. LIST OF REPLACEABLE PARTS.

6-4. A list of replaceable parts for the phase recorder is presented in table 6-1. Information in the table includes the reference designation, TRACOR stock number, part description, the Federal Supply Code of a typical manufacturer that supplies the part, and that manufacturer's part number. The list is divided into subsections that correspond to the assemblies in the instrument. The subsections are listed in numeric order by assembly stock number. Parts are listed in alphanumeric order, by reference designation.

6-5. FEDERAL SUPPLY CODE FOR MANUFACTURERS (FSCM).

6-6. A list of manufacturers supplying parts for the phase recorder is provided in table 6-2. The manufacturers are listed in numerical order by Federal Supply Code number.

6-7. ORDERING INFORMATION.

6-8. Address orders or inquiries to either an authorized TRACOR, Inc., Sales Representative or to:

TRACOR, Inc.
6500 Tracor Lane
Austin, Texas 78721
Attn: Product Service

6-9. To ensure prompt service, orders must include the following information:

a. Name, model, and serial number of the instrument.
b. Reference designation, if applicable.
c. Assembly or sub-assembly name and/or number.
d. TRACOR stock number.
e. Full description of the part.

6-10. The part numbers shown will change occasionally as manufacturers' items are reevaluated or as improved components become available. The component shipped will be the component used in production at the time the order is received, and will be equivalent to the component it replaces in both dimensions and performance.

Table 6-1. List of Replaceable Parts

SPL020 MANUAL PARTS LIST AS OF 02/17/83

REFERENCE DESIGNATION	TRACOR STOCK NUMBER	DESCRIPTION	TYPICAL MFGR	MANUFACTURER PART NUMBER	
	ASSEMBLY NO ••18448-0001	KIT•ACCESSORY			
1	•569022-0001	MANUAL	19397	569022-0001	
2	•••3650-0008	PAPER CHART ROLL	96853	STYLE H	GULTON
3	•••3487-9502	FUSE 1/2 A 250 VOLT	75915	FUSE 250V 1/2A	
	ASSEMBLY NO •538952-0001	COMP BD ASSY LIN PH D			
2	•549210	DIA SCH 888A	19397	549210	
32	•••4234-0024	SCR PAN HD 4-40X3/8	73734	MS51957-15	
33	•••3869-0183	WASHER LOCK INT NO 4	73734	MS35333-70	
34	•••4189-0004	WASHER FLAT NO 4	73734	AN960-C4	
35	•••3872-0079	NUT HEX 4-40X1/4 AF	36906	MS35649-244	
44	•538953	BLANK PC	19397	538953	
47	••75329-0001	SOCKET IC 14 PIN	00779	583327-1	
48	••24768-0031	PAD XSTR PLASTIC PWR	55285	7403-09FR-54	BERQUIST
C 1	••21485-9101	CAP FXD TA 1 MFD	05397	CSL35F105K (MIL-C-26655/2)	
C 2	••21485-9101	CAP FXD TA 1 MFD	05397	CSL35F105K (MIL-C-26655/2)	
C 3	•••3319-0200	CAP FXD CER 20 PFD	71590	DD-200	
C 4	•••3319-0200	CAP FXD CER 20 PFD	71590	DD-200	
C 5	••24193-0471	CAP FXD ALUM 470MF	73445	ET471X040A02	
C 6	••24193-0471	CAP FXD ALUM 470MF	73445	ET471X040A02	
C 7	•••3324-9102	CAP FXD MYL .1 MFD	56289	192P1J492	
E 1	••23969-0680	TERMINAL 19.25V	15849	7031B	
E 2	••23969-0678	TERMINAL GND	15849	7030B	
E 3	••23969-0680	TERMINAL 19.25V	15849	7031B	
E 4	••23969-0678	TERMINAL GND	15849	7030B	
E 5	••23969-0678	TERMINAL GND	15849	7030B	
E 6	••23969-0680	TERMINAL 19.25V	15849	7031B	
E 7	••23969-0680	TERMINAL 19.25V	15849	7031B	
E 8	••23969-0678	TERMINAL GND	15849	7030B	
E 9	••23969-0680	TERMINAL 19.25V	15849	7031B	
E 10	••23969-0680	TERMINAL 19.25V	15849	7031B	
E 11	••23969-0678	TERMINAL GND	15849	7030B	
Q 1	••••900-3646	TSTR 2N3646	19397	2N3646 OR COMM EQUIV PN3646	
Q 2	••••900-3646	TSTR 2N3646	19397	2N3646 OR COMM EQUIV PN3646	
Q 3	••••900-3646	TSTR 2N3646	19397	2N3646 OR COMM EQUIV PN3646	
Q 4	••••900-3646	TSTR 2N3646	19397	2N3646 OR COMM EQUIV PN3646	
Q 5	••••900-4922	TSTR 2N4922	01295	2N4922	
Q 6	••••900-4922	TSTR 2N4922	01295	2N4922	
R 1	••••204-0471	RES FXD COMP 470. OHM	81349	RC07GF471J (MIL-R-11/81)	
R 2	••••204-0473	RES FXD COMP 47K OHM	81349	RC07GF473J (MIL-R-11/81)	
R 3	••••204-0222	RES FXD COMP 2.2K OHM	81349	RC07GF222J (MIL-R-11/81)	
R 4	••••204-0470	RES FXD COMP 47.0 OHM	81349	RC07GF470J (MIL-R-11/81)	
R 5	••••204-0222	RES FXD COMP 2.2K OHM	81349	RC07GF222J (MIL-R-11/81)	
R 6	••••204-0681	RES FXD COMP 680. OHM	81349	RC07GF681J (MIL-R-11/81)	
R 7	••••204-0471	RES FXD COMP 470. OHM	81349	RC07GF471J (MIL-R-11/81)	
R 8	••••204-0473	RES FXD COMP 47K OHM	81349	RC07GF473J (MIL-R-11/81)	
R 9	••••204-0222	RES FXD COMP 2.2K OHM	81349	RC07GF222J (MIL-R-11/81)	
R 10	••••204-0470	RES FXD COMP 47.0 OHM	81349	RC07GF470J (MIL-R-11/81)	
R 11	••••204-0222	RES FXD COMP 2.2K OHM	81349	RC07GF222J (MIL-R-11/81)	
R 12	••••204-0681	RES FXD COMP 680. OHM	81349	RC07GF681J (MIL-R-11/81)	
R 13	••••204-0102	RES FXD COMP 1.0K OHM	81349	RC07GF102J (MIL-R-11/81)	
R 14	••••203-0101	RES FXD COMP 100. OHM	81349	RC42GF101J (MIL-R-11/71)	
R 15	••••204-0102	RES FXD COMP 1.0K OHM	81349	RC07GF102J (MIL-R-11/81)	
R 16	••••204-0101	RES FXD COMP 100. OHM	81349	RC07GF101J (MIL-R-11/81)	
R 17	••••204-0102	RES FXD COMP 1.0K OHM	81349	RC07GF102J (MIL-R-11/81)	
R 18	••••204-0102	RES FXD COMP 1.0K OHM	81349	RC07GF102J (MIL-R-11/81)	
U 1	••••4201-7400	IC SN7400N	01295	SN7400N	
U 2	••24201-0010	IC SN7410N	01295	SN7410N	
CR 1	••••800-0662	DIODE 1N662	01295	1N662	
CR 2	••••800-0662	DIODE 1N662	01295	1N662	
CR 3	••••300-4384	DIODE 1N4384	93332	1N4384	
CR 4	••••800-0964	DIODE 1N964	04713	1N964	
CR 5	••••801-0751	DIODE 1N751A	01281	1N751A	
	ASSEMBLY NO •569956-0001	LIN PHASE RECORD ASSY			
	••18448-0001	KIT•ACCESSORY	19397	18448-0001	
2	•548951-0001	RECORDER	19397	548951-0001	
4	•••3467-0028	CABLE 3-CONDUCTOR	70903	17239	ALLIED
5	•528957-0001	PANEL FRONT 888A	19397	528957-0001	
6	•549210	DIA SCH 888A	19397	549210	
7	•528958-0001	BRACKET	19397	528958-0001	
8	•548959-0001	PANEL REAR	19397	548959-0001	
9	•518960	WIRE LIST	19397	518960	
15	•••3486-0009	LUG SOLDER NO 8	73734	1409	
16	••23969-0049	TERMINAL LUG	83330	1497	
18	••32115-0055	CLAMP CABLE	28520	SK-5P-4	
20	•••5068-0048	STANDOFF H 6-32X3/4	73734	9500	
23	•••3455-0773	CLAMP CABLE 1/4	83330	773	
27	•••4240-0020	SCREW PAN 6-32X .312	96906	MS51957-27	
28	•••4240-0016	SCREW PAN 6-32X .250	96906	MS51957-26	

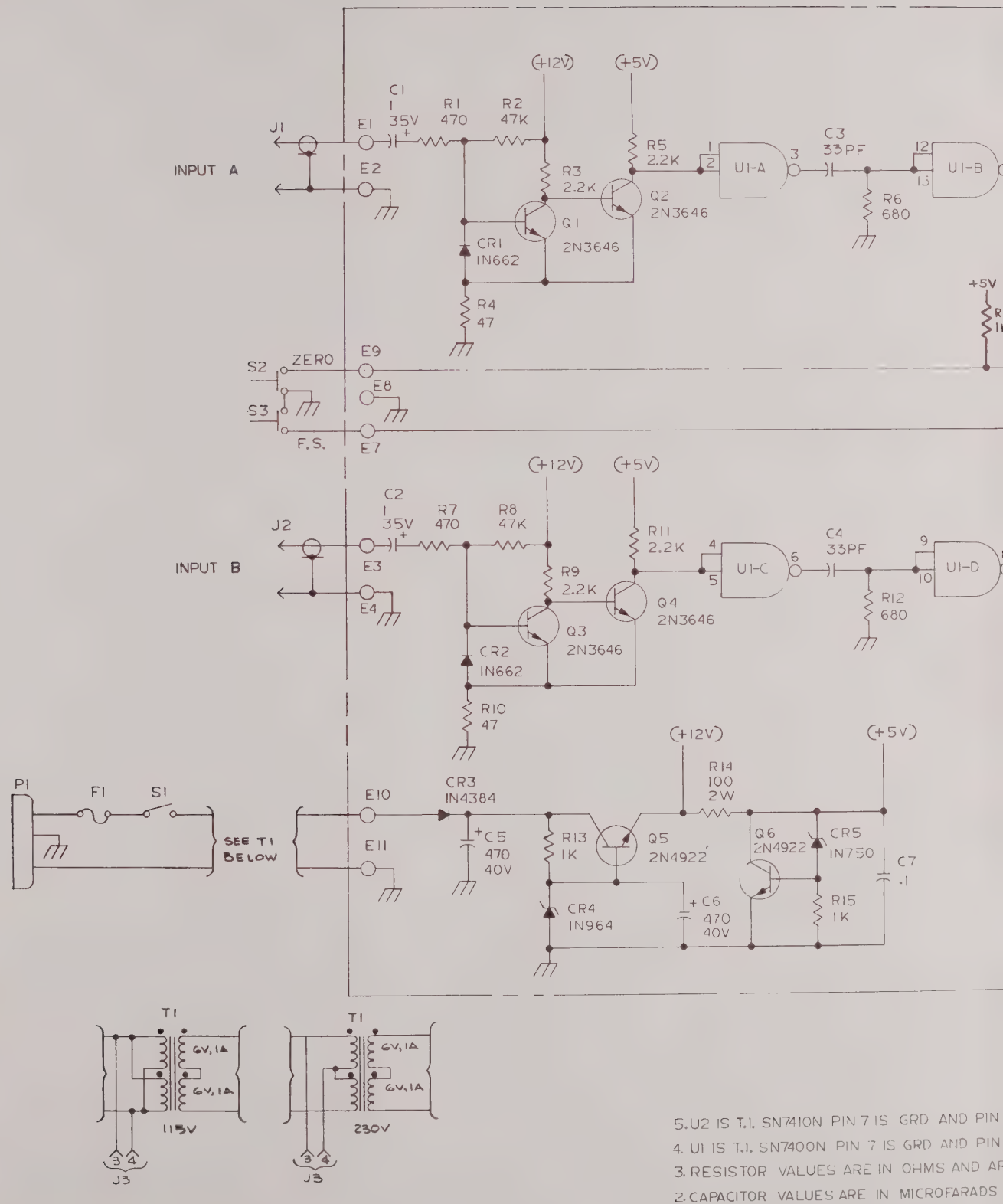
Table 6-1. (Continued)

SPL020 MANUAL PARTS LIST AS OF 02/17/83

REFERENCE DESIGNATION		TRACOR STOCK NUMBER	DESCRIPTION	TYPICAL MFGR	MANUFACTURER PART NUMBER
	29	...4241-0024	SCREW PAN 8-32X.375	96906	MS51957-43
	30	...4239-0024	SCR PAN HD 4-40X3/8	73734	MS51957-15
	33	...3869-0165	WASHER LOCK INT NO 6	73734	MS35333-71
	34	...4189-0006	WASHER FLAT NO 6	73734	AN960-C6
	35	...3869-0136	WASHER LOCK INT NO 8	73734	MS35333-72
	36	...4189-0009	WASHER FLAT NO 8	73734	AN960-C8
	37	...3872-0139	NUT HEX 8-32X11/32 AF	96906	MS35649-284
	38	...3869-0103	WASHER LOCK INT NO 4	73734	MS35333-70
	39	...4189-0004	WASHER FLAT NO 4	73734	AN960-C4
	40	...3872-0079	NUT HEX 4-40X1/4 AF	96906	MS35649-244
	45	..23189-3275	SOLDER .062 DIA	96013	211 ALLOY
	46	...9503-0004	PLATE IDENTIFICATION	19397	9503-0004
	47	...6152-0001	PLATE IDENT	19397	6152-0001
	51	734-2400	WIRE 24AWG BLK STRD	92607	1936TX-10 (MIL-W-16878)
	52	734-2404	WIRE 24AWG YEL STRD	92607	1936TX10 YEL
	53	734-2405	WIRE 24AWG GRN STRD	92607	1936TX-10 (MIL-W-16878)
	54	734-2406	WIRE 24AWG BLU STRD	92607	1936TX10 BLU (MIL-W-16878/4)
	55	734-2408	WIRE 24AWG GRY STRD	70903	1936TX10 GRY (MIL-W-16878/4)
	56	734-2409	WIRE 24AWG WHT STRD	92607	1936TX10 WHT
	57	734-2203	WIRE 22AWG GRN STRD	70903	8406-098N (MIL-W-16878/4)
	58	...3378-0092	CABLE COAXIAL	70903	RG-178B/U (MIL-C-17/93)
	59	...3814-0024	WIRE BUS BAR 24 AWG	70903	[illegible]
	60	...3426-0021	TUBING TEFLON NO 20	92194	TFT-300/300NAT
	61	...4044-0015	STRAP TIE DOWN	06383	SST-1
	62	...3384-0011	TAPE LACING	92194	LC-1344B
	63	...3378-0092	CABLE COAXIAL	70903	RG-178B/U (MIL-C-17/93)
	64	..23477-0003	SCR FLH UNDCT X-REC	73734	4-40X3/16 SST
	65	...3472-0001	SHAFT LOCK BLACK	81453	SL1003
	66	...4389-0107	GALV SGL (NEW) 1 MA	95853	A-3102-101-1-A
A	1	.538952-0001	COMP BD ASSY LIN PH S	12397	538952-0001
C	1	...3324-0102	CAP FXD MYL .1 4PC	56289	192P10492
F	1	...3487-0502	FUSE 1/2 A 250 VOLT	75915	FUSE 250V 1/2A
J	1	..23969-0314	CONN ADPT N SERIES	02660	UG1094A/U
J	2	..23969-0314	CONN ADPT N SERIES	02660	UG1094A/U
J	3	...3048-0008	CONN SOC ELEC	71785	5-330A*
J	4	..23969-0314	CONN ADPT N SERIES	02660	UG1094A/U
J	5	..23969-0314	CONN ADPT N SERIES	02660	UG1094A/U
P	3	...3043-1008	CONN PLUG ELEC	71785	P-330CT
R	1	...3522-0103	RES VAR COMP 10 K	01121	[illegible] (MIL-R-94/5)
S	1	..23959-0171	SWITCH TOGGLE SPST	31356	ST12A
S	2	...3573-0001	SWITCH PUSHBUTTON NC	81073	30-1
S	3	...3573-0001	SWITCH PUSHBUTTON NC	81073	30-1
T	1	..76367-0002	TRANSFORMER 6/12 V	97455	P-6375
XF	1	...3709-0004	HOLDER FUSE	75915	342004

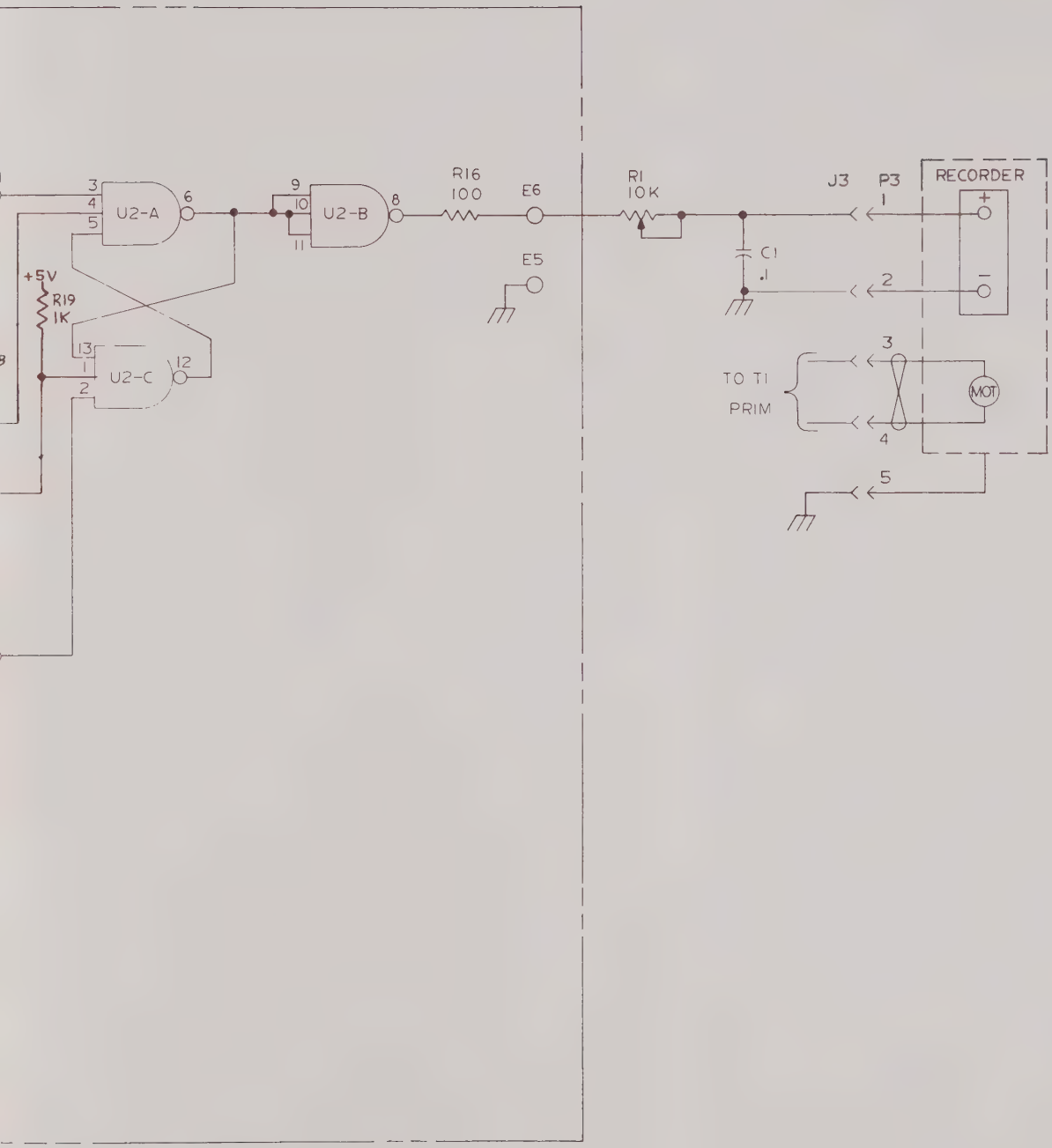
SECTION VII

SCHEMATIC DIAGRAMS



5. U2 IS T.I. SN7410N PIN 7 IS GRD AND PIN
4. U1 IS T.I. SN7400N PIN 7 IS GRD AND PIN
3. RESISTOR VALUES ARE IN OHMS AND AR
2. CAPACITOR VALUES ARE IN MICROFARADS
1. ASSEMBLY IS S-68956

NOTES: UNLESS OTHERWISE SPECIFIED



4 IS VCC
4 IS VCC
: ¼ W, 5%

Figure 7-1. Diagram Schematic
Linear Phase Recorder
Drawing No. S49210D

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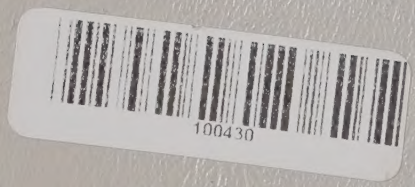
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